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HEAT EXCHANGER AND METHOD

Technical Field

This invention relates to heat exchangers and more particularly to flat plate heat exchangers and a method of making same.

Background Art

Heat exchangers have a wide range of heating and cooling applications wherever heat transfer between two fluids is required. In general in a heat exchanger two fluids, one hot and the other cold, are passed through alternate passages for heat transfer to the two fluids.

Simpelaar No. 2,959,400 discloses a flat plate heat exchanger wherein layers of rectangular sheets are connected at their edges and corner pieces for support and hot and cold fluids are caused to flow in opposite directions and provide an interchange of energy between the two.

Carlson Canadian Patent No. 1,183,834 discloses a flat plate heat exchanger chiefly characterized by flat plates separated by spacers and having inlets and outlets in opposite sides of the heat exchange elements.

Konings European Patent No. 0,040,890 discloses a flat plate heat exchanger with internal baffles establishing a zig zag flow pattern.

Davison et al. No. 5,469,914 discloses a flat plate heat exchangers having stacks of plates with spaces between the plates and forms a V-shape at each end and the two outside plates are made integral with the core.

Disclosure of the Invention

The heat exchanger device and method has a heat exchanger core having a first plate and a second plate and a stack of parallel spaced inner plates between the

first and second plates with spaces between the inner plates defining passages for the flow of hot and cold fluids for heat transfer between the two fluids. The core is made separately and tested for leaks and then a first core retaining plate is affixed to one face of the core and a second core retaining plate is affixed to an opposite face of the core and end wall portions are provided at the opposite ends of the core for forming flow compartments into which fluids may be conducted toward and away from the heat exchanger core. Each of the first and second core retaining plates have a pair of flow apertures at preselected precise locations in relation to flow line connections to which the device is connected for fluid flow. Each pair of flow apertures are in opposite end portions of the core retaining plates beyond the ends of the core.

Brief Description of the Drawings

Details of this invention are described in connection with the accompanying drawings which like parts bear similar reference numerals in which:

Figure 1 is a top plan view of the heat exchanger device embodying features of the present invention.

Figure 2 is a side elevation view of the heat exchanger device.

Figure 3 is an end elevation view of the heat exchanger device.

Figure 4 is an exploded view partially broken away of the heat exchanger device.

Figure 5 is an exploded view of the heat exchanger shown in Figures 1-4 prior to assembly and welding.

Figure 6 is a sectional view taken along lines 6-6 of Figure 2.

Figure 6A is a sectional view along line 6A-6A showing a detail showing the weld of step

2 of the welding procedure.

Figure 7 is a sectional view taken along line 7-7 of Figure 2.

Figure 8 is a sectional view taken along line 8-8 of Figure 2.

Figure 9 is a perspective view of two of the flat inner plates before assembly.

Figure 10 is a perspective view of another heat exchanger device with the same core and four straight on end caps.

Detailed Description

Referring now to the drawings there is shown a heat exchanger device 12 having an oblong housing of body 13, two flow connectors 14 and 15 on one face herein shown as the top of the body and two flow connectors 16 and 17 on the bottom of the other face herein shown as the body 13. Each flow connector shown and with reference to connector 14 has a tubular portion 18 and a circular flange portion 19 with a center hole 20 and with four circumferentially spaced holes 21 in the flange portion 19 for mounting purposes.

There is a preselected fixed longitudinal distance between the center lines of connectors 14 and 15 designated X1 and a preselected lateral distance designated Y1 and a preselected fixed longitudinal distance between the center line of connectors 16 and 17 designated X2 and a preselected lateral distance designated Y2. There is a preselected fixed distance between the center lines may be precisely located using the attachable core retaining plates described hereafter.

The length of the connectors 14, 15, 16 and 17 along the center lines may also vary to meet preselected mounting requirements. The length between the ends of connectors 14 and 16 is designated Z1 and the length between the ends of connectors 15 and 17 is designated

22. The end-to-end dimensions of the connectors 14 and 16 and between 15 and 17 according to the present invention may be readily varied to meet any installation requirements.

The body 13 includes a heat exchanger core 22 having a first plate 23 shown at the top, second plate 24 shown at the bottom with a stack of parallel spaced inner plates 26 between the first and second plates with spaces between the inner plates defining alternate flow passages for hot and cold fluids. Insert C1 C1 The ~~how~~ hot flow passage is designated A and the cold flow passage is designated B with a solid arrow showing hot fluid and the dashed arrow showing cold fluid.

Referring now to Figure 9 the inner plates 26 and 27 of core are shown to have a downwardly inclined end section 28 along half the width and an upwardly inclined section 29 along the other half the width at one end of the plate. There is an upwardly inclined end section 29 along half the width and a downwardly inclined end section 28 along the other half of the width at the other end. Each inclined end section has a straight end section 30 parallel to the plane of the plate. Insert G1 a1 ~~The next lower inner plate 26 is turned end for end relative to the plate 26 above~~ so that the downwardly inclined end section 28 of the upper inner plate 27 fits against an upwardly inclined end section 29 of the lower inner plate 26 along one half the plate and the upwardly inclined section 29 of the upper inner plate 27 and a downwardly inclined end section 28 on the other half at one end flare away. This is reversed at the other end so the flow is diagonally across the plates. A longitudinal edge spacer 31 extends along both edges between the plates to separate the plates. Insert a2 a2 ~~The~~ diverging end sections and converging end sections alternate from the top to the bottom of the core. As seen in Figure 6A the longitudinal spacer between the diverging end sections extends further than the

longitudinal spacer between the converging end sections. The diverging end sections are welded along the abutting flat end surfaces 30. The plate 26 has indentations or dimples 35 in a preselected pattern which provide strength and maintain spacing between plates.

In accordance with the present invention the core is made first, tested for leaks and then first and second core retaining plates 41 and 42 are secured to opposite faces of the core, respectively herein shown as the top and bottom of the core. The first core retaining plate 31 has opposed first end portions 44 and 45 that extend beyond the ends of the core and similarly the second plate 42 has opposed second end portions 46 and 47 that extend beyond the ends of the core. The first plate 41 has a pair of opposed apertures 51 and 52 and end portions ~~54 and 55~~ 44 and 45, respectively, that are precisely located in relation to the flow line connections to which the device is connected. The second plate 42 has a pair of opposed apertures 53 and ~~44~~ 54 in the end portions 46 and 47, respectively, that are also precisely located in relation to flow line connectors to which the device is connected.

A first end wall portion 60 at one end of the core 22 includes three spaced longitudinally extending divider plates 61, 62 and 63 and two end plates 64 and 65 secured at one end of the core 22 between the end portions of the first and second core retaining plates to form first flow compartment 68 in flow communication with opening 51 and a second flow compartment 69 in flow communication with opening 53. A second end wall portion 70 identical to end wall portion 60 includes three spaced, longitudinally extending divider plates 71, 72 and 73 and ~~two end plates 84 and 85~~ two end plates 74 and 75 to form a third flow compartment ~~88~~ 78 in flow communication with opening 54 and a fourth flow compartment ~~89~~ 79 in flow communication with opening ~~44~~ 52.

The core 22 is frequently made of an exotic material such as titanium. The above construction allows the core to be tested for leaks before final weldments to the core retaining plates and allows for repair should a leak be detected. The use of separate plates for strengthening of the core also allows the flow apertures to be at precise positions in relation to the equipment to which they are attached. Frequently, the equipment to which they are attached such as pumps or molds is a very close fitting arrangement and precise close tolerances are required to attach the exchanger to associated equipment.

According to the method of the present invention in making core 22 the first step is to weld the end joints of each inner plate at the edges of the inclined sections at both ends of the plates. Several of the weld joints are indicated by the letter W. The second step has the welding of the side corner joints between the inner plates and spacers closed as shown in Figure 6A. Preferably a filler wire is used. The third step involves closing the end joint corners and filler wire is used. Step four involves welding the center of the end joint weld which separates the fluid cavities with a filler wire weld. The fifth step involves the welding of the edge spacer and inner plate joints. At the end of the fifth step the heat exchanger core 22 is completed and is tested for leaks between fluid cavities as well as any external leaks.

In the sixth step the fluid connectors 14-17 are welded to the outside of the core retaining plates 41 and 42. The seventh step involves having the heat exchanger core located on the bottom outside retaining plate and equal distance from the end and welding the plate across the width of the plate with a filler wire using a fillet weld. The eighth step involves welding the center divider plates 62 and 72 to the heat exchanger

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core and to the outside core retaining plate. In step nine the top outside core retaining plate is welded to the heat exchanger core 22 across the width and at the joint created with the center plate. Step ten involves welding the side plates 61, 63, 71 and 73 to the core and to the top and bottom of the retaining plates. In step eleven the end plates 64, 65, 74 and 75 are welded to the top and bottom core retaining plates 41 and 42 and the center plates 62 and 72. The device is then complete and again tested for leaks.

Referring now to Figure 10 there is shown a core 22 having four identical straight on end flow connectors or caps 82 connected to the opposite ends of the core 22 to pass the hot and cold fluids straight on or longitudinally from the ends in a linear flow. These end flow connectors or caps 82 have a hollow rectangular base section 83 with two side by side corresponding with the size of the end of the core and a tubular section 84 with external threads for line connecting purposes. With this embodiment the core can be tested prior to installing the end connectors.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details of structure may be made without departing from the spirit thereof.

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